REMARKS

By this Amendment, claims 1-17 are amended. Thus, claims 1-17 are active in the application. Reexamination and reconsideration of the application are respectfully requested.

The specification and abstract have been carefully reviewed and revised in order to correct grammatical and idiomatic errors in order to aid the Examiner in further consideration of the application. The amendments to the specification and abstract are incorporated in the attached substitute specification and abstract. No new matter has been added.

Also attached hereto is a marked-up version of the substitute specification and abstract illustrating the changes made to the original specification and abstract.

In item 2 on page 2 of the Office Action, claims 5, 6 and 17 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the Applicants regard as the invention.

In particular, in item 3 on page 2 of the Office Action, the limitations of "said first control" and "said second control" in original claims 5 and 6 were asserted to be indefinite because claim 4, from which claims 5 and 6 depend, already establishes what the first and second controls are what the first and second controls perform.

Claim 5 has been amended to clarify that the first control and the second control are the inverter control circuit controlling the inverter circuit for driving a DC brushless motor. In particular, when performing the first control, amended claim 5 defines that the inverter control circuit increases the value of the output current or output voltage of the inverter circuit by advancing the phase of the output current or output voltage of the inverter circuit. When performing the second control, amended claim 5 defines that the inverter control circuit decreases the value of the output current or output voltage of the inverter circuit by delaying the phase of the output current or output voltage of the inverter circuit.

Claim 6 has been amended to clarify that the first control and the second control are the inverter control circuit controlling the inverter circuit for driving an induction motor. In particular, when performing the first control, amended claim 6 defines that the inverter control circuit increases the value of the output current or output voltage of the

inverter circuit by decreasing the angular velocity of the output current or output voltage of the inverter circuit. When performing the second control, amended claim 6 defines that the inverter control circuit decreases the value of the output current or output voltage of the inverter circuit by increasing the angular velocity of the output current or output voltage of the inverter circuit.

The Applicants respectfully submit that amended claims 5 and 6 are clearly consistent with and further define the limitations recited in claim 4. Therefore, the Applicants respectfully request the Examiner to withdraw the rejection of claims 5 and 6 under 35 U.S.C. § 112, second paragraph.

In item 4 on page 2 of the Office Action, the Examiner asserted that the term "type" in original claim 17 renders the claim indefinite because the term "type" is a relative term and the specification does not provide a standard for ascertaining the requisite degree in order to allow one of ordinary skill in the art to be reasonably apprised of the scope of the invention.

The Applicants respectfully note that the specification clearly indicates that the heat pump type hot-water supply unit is a boiler using a heat exchanger. Therefore, the Applicants respectfully submit that the specification provides a standard for ascertaining that the heat pump type hot-water supply unit is one type of a boiler unit among different kinds of boiler units using different heating manners, such as a gas boiler and an oil-fired boiler.

Nevertheless, to overcome the rejection of claim 17 under 35 U.S.C. § 112, second paragraph, claim 17 has been amended to recite "a heat pump hot-water supply unit" instead of "a heat pump type hot-water supply unit." In view of this revision to claim 17, the Applicants respectfully request the Examiner to withdraw the rejection of claim 17 under 35 U.S.C. § 112, second paragraph.

In item 6 on page 2 of the Office Action, claims 1, 3, 7-8, 10-11, 14 and 16-17 were rejected under 35 U.S.C. § 102(b) as being anticipated by Doyama et al. (U.S. 5,646,499). Without intending to acquiesce to this rejection, independent claim 1 has been amended to more clearly illustrate the marked differences between the present invention and the applied references.

Accordingly, the Applicants respectfully submit that the present invention is clearly patentable over the applied references for the following reasons.

The present invention provides a motor driving apparatus for driving a motor. The motor driving apparatus of the present invention includes a rectifier circuit having an input to be connected to a single-phase AC power supply, and an inverter circuit connected to the rectifier circuit, where the inverter circuit is operable to output a current and a voltage to the motor. The motor driving apparatus of the present invention also includes an inverter control unit which is operable to control the inverter circuit so as to drive the motor. The inverter control unit includes a power supply voltage estimate unit which is operable to estimate a voltage of the single-phase AC power supply.

An important feature of the present invention is controlling an output voltage of the inverter circuit so that a waveform of an input voltage of the inverter circuit becomes equal or approximate to a waveform of an output voltage of the AC power supply. This feature of the present invention is exemplarily explained in lines 9-14 on page 31, line 22 on page 41 to line 17 on page 42, line 20 on page 50 to line 18 on page 51, and line 13 on page 58 to line 10 on page 59 of the original specification, for example (corresponding to lines 7-12 on page 30, line 15 on page 40 to line 8 on page 41, line 12 on page 49 to line 9 on page 50 and lines 2-25 on page 57 of the substitute specification). As a result of this feature, the motor driving apparatus of the present invention can minimize degradation of a power factor due to waveform distortion of the current outputted from the AC power supply, and thereby lower the reactance which is necessary for circuit construction.

Claim 1 has been amended to recite this important feature of the present invention. In particular, claim 1 defines the inverter control unit as including a power supply voltage estimation unit operable to estimate a voltage of the single-phase AC power supply. Furthermore, claim 1 recites that the inverter control unit is operable to change the value of the current or voltage outputted from the inverter circuit so that a waveform of an input voltage of the inverter circuit becomes equal or approximate to a waveform of an absolute value of an output voltage from the single-phase AC power supply, based on the power supply voltage estimated by the power supply voltage estimation unit.

In contrast to the motor driving apparatus of claim1, Doyama et al. discloses a control apparatus for controlling an inverter which drives a motor by a rectified AC voltage. In essence, the inverter control apparatus of Doyama et al. compensates for a difference in a desired rotational speed of a motor and an actual detected rotational speed of the motor, where an output voltage of the inverter is increased or decreased so as not to increase the amount of power supplied to the motor, and thereby minimize electric power consumption in the motor. Duyama et al. also discloses that an amplitude of the driving current of the motor, which is driven by the inverter, is detected based on the output of a current sensor 3, and that the inverter is controlled based on the detected amplitude of the driving current of the motor (see Column 13, line 52 to Column 14, line 48).

However, Duyama et al. does not disclose or suggest that the inverter control apparatus changes the value of the current or voltage outputted from the inverter circuit so that a waveform of an input voltage of the inverter circuit becomes equal or approximate to a waveform of an absolute value of an output voltage from the single-phase AC power supply, based on the power supply voltage estimated by the power supply voltage estimation unit, as recited in claim 1.

Accordingly, claim 1 is clearly not anticipated by Duyama et al. since Duyama et al. fails to disclose each and every limitation of claim 1.

Furthermore, the Applicants respectfully submit that claim 1 is also not rendered obvious over Duyama et al. since Duyama et al. clearly fails to disclose or suggest each and every limitation of claim 1.

Therefore, the Applicants respectfully submit that claim 1 is clearly patentable over Duyama et al. for at least the foregoing reasons.

In item 8 on page 3 of the Office Action, claims 13 and 15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Doyama et al. In item 9 on page 4 of the Office Action, claims 2 and 4 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Doyama et al. in view of Mose et al. (U.S. 4,876,637). In item 10 on page 4 of the Office Action, claims 2, 4 and 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Polo et al. (U.S. 6,254,353). In item 11 on page 5 of the Office Action, claim 5 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Doyama et al. in view of Polo et al. and further in view of Takahashi et al. (U.S.

6,002,220). Finally, in item 12 on page 6 of the Office Action, claims 9 and 12 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Doyama et al. in view of Takagi et al. (U.S. 6,367,273).

As demonstrated above, Doyama et al. clearly fails to disclose or suggest each and every limitation of claim 1. For the following reasons, the Applicants respectfully submit that Mose et al., Polo et al., Takahashi et al. and Takagi et al., either individually or in combination, do not cure the obvious deficiencies of Doyama et al. for failing to disclose or suggest each and every limitation of claim 1.

Mose et al. discloses a power converter for driving an AC motor by a rectified AC voltage, in which a preparation for an instant power interruption is provided. Mose et al. also discloses increasing the current that is supplied to the AC motor in a case where the rectified AC voltage is smaller than the value corresponding to the motor speed at the time that the AC power supply is recovered from power interruption (see Column 5, lines 48-66).

Polo et al. discloses a system for controlling the operation of a submersible pump, in which various conditions of the system are detected (e.g., stalling due to debris or other interferences) and a motor for driving the pump is controlled according to the detected condition. Polo et al. also discloses that the motor speed is decreased when the motor current is greater than a first preselected current and that the motor speed is increased when the motor current is less than a second preselected current (see Column 3, line 58 to Column 4).

Takahashi et al. discloses an air-conditioning system which stores surplus electric power during the night when the demand for electric power is low, and which uses the stored electric power during the day when the demand for electric power is high. Takahashi et al. also discloses controlling a charging current in storing the electric power so as to approach a target value of the charge current (see Column 8, line 40 to Column 9, line 36).

Takagi et al. disclose a refrigerator having an inverter for driving a motor by a rectified AC voltage, and a circuit configuration in which a reactor is connected to an output of a rectifier.

Even with these disclosures, the Applicants respectfully submit that no obvious combination of Doyama et al., Mose et al., Polo et al., Takahashi et al. and Takagi et al. would result in the invention of claim 1 for the following reasons.

Doyama et al. discloses a control apparatus for controlling the output voltage of the inverter based on the detected motor driving current. The control of the inverter disclosed in Doyama et al. is one which increases or decreases the output of the inverter according to whether or not a power supplied to the motor was increased when the output of the inverter was previously changed.

In contrast, the motor driving apparatus of claim 1 provides that the inverter control unit is operable to change the value of the current or voltage outputted from the inverter circuit so that a waveform of an input voltage of the inverter circuit becomes equal or approximate to a waveform of an absolute value of an output voltage from the single-phase AC power supply.

Accordingly, in contrast to the present invention, Doyama et al. cannot provide an effect of minimizing degradation of a power factor due to waveform distortion of the current which is input to the motor driving apparatus, as achieved by the motor driving apparatus of claim 1.

Mose et al. and Polo et al. merely disclose increasing or decreasing the driving current of a motor which is to be controlled, according to an operational condition of the motor. Mose et al. and Polo et al., however, clearly do not disclose or suggest that an inverter output voltage is controlled so as to make an input voltage waveform of the inverter equal or approximate to a waveform of an absolute value of the AC power supply, as recited in claim 1.

Furthermore, Takahashi et al. discloses a power storage air-conditioning system for storing (charging) current in the system when load on the system is light so that the stored current can then be used when the load on the system increases. Takagi relates to a circuit in which a reactor is provided between the inverter for driving the motor and the rectifier arranged at a pre-stage of the inverter. Accordingly, Takahashi et al. and Takagi et al. do not even contemplate minimizing degradation of a power factor due to waveform distortion of the current which is input to the motor driving apparatus, and therefore, adding Takahashi et al. and Takagi et al. to the robust collection of references would still

not achieve the invention of claim 1. Furthermore, similar to Doyama et al., Mose et al. and Polo et al., Takahashi et al. and Takagi et al. clearly do not disclose or suggest that an inverter output voltage is controlled so as to make an input voltage waveform of the inverter equal or approximate to a waveform of an absolute value of the AC power supply, as recited in claim 1.

Therefore, no obvious combination of Doyama et al., Mose et al., Polo et al., Takahashi et al. and Takagi et al. would result in the invention of claim 1 since Doyama et al., Mose et al., Polo et al., Takahashi et al. and Takagi et al., either individually or in combination, clearly fail to disclose or suggest each and every limitation of claim 1.

Furthermore, it is submitted that the clear distinctions discussed above are such that a person having ordinary skill in the art at the time the invention was made would not have been motivated to modify Doyama et al., Mose et al., Polo et al., Takahashi et al. and Takagi et al. in such as manner as to result in, or otherwise render obvious, the present invention as recited in claim 1.

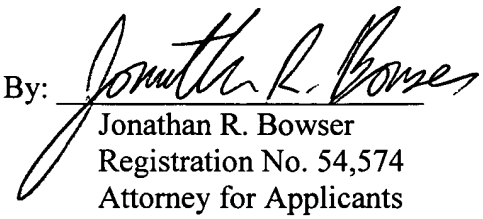
Therefore, it is submitted that the claim 1, as well as claims 2-17 which depend therefrom, are clearly allowable over the prior art as applied by the Examiner.

In view of the foregoing amendments and remarks, it is respectfully submitted that the present application is clearly in condition for allowance. An early notice thereof is respectfully solicited.

If, after reviewing this Amendment, the Examiner feels there are any issues remaining which must be resolved before the application can be passed to issue, the Examiner is respectfully requested to contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

Mitsuo UEDA et al.

By: 

Jonathan R. Bowser
Registration No. 54,574
Attorney for Applicants

JRB/nrj
Washington, D.C. 20006-1021
Telephone (202) 721-8200
Facsimile (202) 721-8250
December 6, 2005